

# A Hybrid Knowledge Based System for Therapy Adjustment in Gestational Diabetes

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## ABSTRACT

*This poster describes a system to analyze self-monitoring data of gestational diabetic patients, for obtaining an assessment of their metabolic control with the final goal of supporting decision-making in therapy adjustment. The system is able to manage incomplete data and to make temporal reasoning under uncertainty, the two most important constraints when analyzing ambulatory monitoring data. Two different formalism have been used to represent and manage the knowledge: a dynamic Bayesian network and a production system based on rules. The outcomes provided by the whole system are: information on possible patient transgressions of the prescribed treatment and recommendations of treatment adjustments.*

## INTRODUCTION

Gestational diabetes affects 5% of pregnant women. This disease is manifested with high blood glucose concentrations and ketonuria. Complications can be avoided if normoglycaemia levels are achieved during pregnancy with a carefully planned diet and external insulin administration. Patient metabolism changes along time, and that motivates the need of continuous therapy modifications. Ambulatory monitoring in gestational diabetes implies patient self-monitoring measurements that are characterized by: 1) uncertainty in data reliability, and 2) frequent missing data.

The assessment of the metabolic patient state can be addressed using mathematical physiological models of glucose metabolism. The limitation of these approaches is that diet and insulin data, including timing, must be known to perform a feasible simulation. When ambulatory monitoring data are missed, it is not correct to assume data from the prescribed therapy, because patients do not strictly follow the prescribed diet and insulin therapy, and it is not feasible to request to them to record all their actions and modifications. To cope with these

constraints, we propose a system that obtains the evolution of the patient metabolic state associated to a degree of uncertainty, according to the type, amount and reliability of monitoring data.

## DESCRIPTION

Our approach is a hybrid knowledge based system that propose therapy adjustments by analyzing the patient ambulatory monitoring data. Two different formalism have been used to represent and manage the knowledge: dynamic Bayesian networks (DBN) and rules. Each of them is adequated to represent a different type of knowledge and to make a different type of reasoning, as described below.

First, a DBN is used to obtain the temporal evolution of the patient metabolic state from her monitoring data. This formalism can represent qualitative medical knowledge expressed as relations between causes and effects and their probabilities, and it also allows to make temporal reasoning under uncertainty of incomplete data. A DBN contains several dynamically chained subnetworks where temporal data can be entered. In our case, the basic structure is a network with 50 nodes that represents the metabolic situation for a day. The second step uses the production rule system to propose quantitative therapy modifications. The knowledge and data involved in this reasoning process are: the previously obtained patient metabolic state; the specific patient characteristics; the current therapy; and therapy modification criteria.

A prototype has been implemented in Ansi C on a Sun SparcStation. We have used the commercial software Hugin to develop the daily causal probabilistic network structure, a DBN software from Aalborg University, Denmark, to manage the dynamic structure and CLIPS 6.0 to implement the rule-based formalism.